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DISEASES OF BEES.

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CONTENTS.

THERE has been a good deal of work done during the last few years on the bacteriology of bee diseases, which has added considerably to our knowledge. Professor Maassen and Professor Zander in Germany, Professor Burri in Switzerland, and Dr. Franklin White in America, have by their researches done much to elucidate problems which had previously been very obscure.

Diseases of the honey bee are most conveniently divided into two main groups: (1) Those affecting the larvae, and (2) those affecting the adult bee.

I.—DISEASES OF LARVAE.

By far the most important diseases in this group are those classed as "Foul Brood." Until a comparatively short time ago all cases of foul brood were believed to be due to the same cause. In 1886 Cheshire and Cheyne described a spore-bearing bacillus, named by them *B. alvei*, which they found constantly present in dead larvae in foul brood, and for many years this bacillus was regarded as the sole cause of the disease.

In 1902 White described a second variety of foul brood which was common in the United States; the cause of this appeared to be another spore-bearing bacillus, which he named *B. larvae*, and the disease caused by this organism is generally known in the United

States as American foul brood, while that in which *B. alvei* is present is known as European foul brood.

Shortly after this Maassen described an organism which he found present in a large number of cases of foul brood in Germany, which appeared to be not a bacillus but a spirochaete, a protozoal organism. White soon pointed out that what Maassen had taken for a spirochaete was nothing more than a mass of twisted flagella from the bacillus he had already studied and named *B. larvae*. Maassen subsequently acknowledged that this was the case and that he had been mistaken in thinking that these masses of flagella were spirochaetes. He afterwards found the bacillus from which these flagella came, and named it *B. brandenburgiensis*, though it is certainly the same organism as that which White had already named *B. larvae*. Quite recently Maassen and Burri have independently described another variety of foul brood which appears to be caused by a different organism, namely *Streptococcus apis*. This micrococcus is, however, frequently associated with *B. alvei*, and it is doubtful whether it is the primary cause of the disease or only an associated organism.

White considers that there is some reason to doubt whether *B. alvei* is really the cause of European foul brood. The original work done by Cheshire and Cheyne does not seem quite conclusive as to whether they actually produced infection in healthy brood by spraying with pure cultures of *B. alvei*. It is not denied that this organism is constantly present in cases of so-called European foul brood, but so far attempts to produce the disease in healthy brood by infection have failed.

There appears to be some reason for believing that a different organism may be the real cause of the disease. White finds that there is frequently to be seen in smears from dead larvae an organism which somewhat resembles *Streptococcus apis*, but it is not identical with it. Up to the present time it has been found impossible to cultivate this organism, so that judgment must be suspended until more work has been done on the subject as to the part it plays in the production of foul brood.

There can be no doubt as to the *B. larvae* being the pathogenic agent in American foul brood, as infection experiments have been uniformly successful in producing the disease in healthy brood. This bacillus, as has been said, is a spore-bearing organism which possesses numerous long flagella; these break off very easily and collect together in twisted masses, and can often be demonstrated in dead larvae when it is impossible to find either bacilli or spores. The organism is difficult to cultivate, and must be grown either on a

medium made from the juice of dead larvae, or on one which is prepared from animal brain extract, instead of the ordinary meat juice. Although the two principal varieties of foul brood have much in common yet there are some points which help to differentiate the two, apart from bacteriological examination.

In both forms there is a foul odour in the diseased combs when an affected hive is opened. German observers think they can distinguish between the two forms of the disease by the smell which they describe, but possibly the microscope would not confirm the nasal diagnosis.

Maassen is of opinion that the sealed brood is more often affected by *B. brandenburgiensis* (or *larvae*), while the disease in unsealed brood is more commonly due to *B. alvei*. In both forms there is considerable ropiness in the dead larvae; that is to say, if a splinter of wood be introduced into a cell containing a dead larva, the decomposing mass adheres to the wood and may be drawn out in a long glutinous thread. This ropiness is said to be due to the persistence of the chitinous tracheae after the softer tissues have broken down; and the condition is more marked in the case of American than in European foul brood.

Other organisms have been described as being the cause of foul brood, but the part they play in the production of disease is not sufficiently well known to warrant any conclusions being arrived at with regard to them at present.

In all forms of the disease propagation and infection are almost certainly due to bees from healthy hives entering diseased ones for the purpose of robbing, and conveying the disease in the stolen honey or pollen which they carry away. This is by far the most common and important means of spreading the disease, but it is possible that infection may also be conveyed to healthy hives by the bee-keepers hands or utensils which have not been properly disinfected after being employed on a diseased hive.

Treatment of Foul Brood. In the opinion of most competent observers, there is only one safe method for treating an outbreak of foul brood. This consists in driving the bees from the affected into a clean hive or skep, and shutting them up for twenty-four or forty-eight hours. All the combs in the infected hive must be destroyed by burning them, as it is not worth while trying to preserve the wax or to attempt to disinfect them, in fact it is almost impossible to do the latter as the spores can resist the temperature of boiling water and are not destroyed by any of the ordinary disinfectants.

The infected hive must be thoroughly cleaned and the interior

burnt off with a painter's flare to destroy any spores which may remain on the woodwork. At the end of forty-eight hours the bees may be safely transferred to a fresh hive provided with clean combs or foundation wax, as by the end of that time they will have digested all the stores they took with them from their original hive, and inasmuch as adult bees are not affected by the disease they will have destroyed all the bacilli in their digestive tracts or passed the spores in their excrement. The hive which has been temporarily occupied must be carefully disinfected. This method of treatment, if thoroughly carried out, is found in nearly every case to stop the spread of the disease, and ought to be adopted by every bee-keeper as soon as he discovers that one of his stocks is affected. It is not advisable to feed with medicated syrups or to spray the combs with disinfectants, for although some cases of cure by these means have been reported, it is unsafe to rely upon them since they are useless in destroying the spores, and if these remain the disease will undoubtedly break out again.

Other Forms of Brood Disease.—Other forms of brood disease which lead to the death of the larvae are not generally supposed to be infectious. Among these may be mentioned Chilled brood, in which the larvae perish from cold or neglect; Pickle brood, which is supposed to be due to diminished fertility on the part of the queen and in consequence to the feeble vitality of the larvae. Black brood, which is probably only a variety of Chilled brood, in which the black appearance of the dead larvae is due to a particular kind of putrefactive organism. It is found in most cases in which the larvae perish without any infectious disease being present, that the dead grubs swell up and protrude from their cells if unsealed, or burst the caps if they do not die till after this process is completed. On the other hand in foul brood the larvae do not develop properly, are smaller than they ought to be, and after death shrink so that the cell caps appear sunken. This will often enable a bee-keeper to distinguish between larvae dead from disease and those who have perished from cold or some other cause.

Diseases of the Adult Bee.

Malignant Dysentery.—Professor Zander, of Erlangen, in 1909 described a form of dysentery which appears to be very prevalent in Bavaria, and is extremely virulent and infectious; he believes that many more stocks are destroyed by this disease than by foul brood. The complaint usually makes its appearance during the spring months, and rapidly kills all the bees in an infected hive. It may

appear to die down for a time, but generally lights up again, cases of complete recovery after an attack being very rare. Bees suffering from this complaint rapidly lose their power of flight, and are therefore unable to leave the hive in order to void their excrement, and in consequence foul the interior of the hive and alighting board. Many of the bees in their attempts to fly fall on the ground in front of the hive and there perish. Zander discovered that this disease was due to a protozoal parasite, and has named it *Nosema apis*. This parasite, when swallowed, makes its way into the epithelial cells, lining the chyle stomach and there rapidly multiplies. When it has exhausted its food supply it passes into a resting form or spore, and it is in this condition that it is usually found. These spores are oval, translucent, highly refractile bodies, considerably larger than bacterial spores, being about the size of yeast cells. Many thousands are passed in the excrement of an affected bee, and may remain alive for an indefinite time, as they are extremely resistant to heat, cold, or dessication. If the digestive tract of a bee dying from this complaint be examined the chyle stomach is sometimes found to have lost its natural pink colour and to be pearly white; this is due to the enormous numbers of *Nosema* spores which completely fill the secreting cells lining the chyle stomach. There does not appear to be any chance of saving a stock which has become infected with malignant dysentery, so that the only possible treatment is to destroy the bees and combs and thoroughly disinfect the hive and the ground in its neighbourhood which may have become contaminated by the dead bees or their excrement.

Simple Dysentery.—Non-malignant dysentery is a very different disease and appears to be caused either by spells of cold weather after warm days in the spring, or feeding the bees with too watery syrup or one made from inferior sugar. Bees affected by this complaint become weak and unwilling to fly, they void their excrement, which is usually thin and watery, on the combs and other parts of the hive. Some individuals die, but a stock usually recovers if proper steps are taken to put a stop to the trouble; these consist in keeping the bees warm and feeding with candy or good thick syrup.

May Sickness.—This complaint has not been described in this country, but it appears to be prevalent on the Continent of Europe about the month of May. The descriptions given by different writers of this disease are most conflicting, and various organisms have been described as being the cause of it. Professor Zander is inclined to believe that many cases of malignant dysentery have been put down to May sickness, if indeed it is not merely another name for that complaint.

Paralysis.—This does not appear to be a common affection in this country, but it is somewhat common in Ireland, and occurs in most other countries in which bee-keeping is practised. Bees affected by this complaint become unable to fly, and exhibit a curious tremulous motion of their bodies, which lose their healthy appearance and become black and shining. The cause of the disease has not at present been discovered, but it is not usually supposed to be infectious, and affected stocks generally recover after a shorter or longer period.

Isle of Wight Disease.—During the summer of 1904 an apparently new disease made its apperance in the Isle of Wight, and in the course of a few years practically exterminated the bees in the island. How the complaint originated it is impossible to say. When a hive is attacked it is noticed that the bees seem disinclined to work, and either fly aimlessly about or sit on the combs. They become lethargic and soon lose their power of flight, and in consequence large numbers of them fall on the ground near the hive, and as they are unable to regain it they quickly perish. The disease seems to be most prevalent and to spread most rapidly during the early summer months, but no time of year is exempt, many stocks perishing during the winter. Only the adult bees are effected; the larvae remain healthy, as do also the young bees, and it is only rarely that drones take the complaint. On more than one occasion a hive has been opened and found to contain a live queen, while all the other bees had perished. In nearly every instance in which accurate observations have been made it has been found that the disease was introduced into a healthy hive by foragers who had entered infected hives for the purpose of robbing; this clearly points to its infectious nature.

If a bee suffering from the disease be examined, it is usually found to be heavy, disinclined to move or use its sting, its wings are frequently dislocated and stick out in unnatural positions, the abdomen is swollen and inclined to droop posteriorly. On opening the abdomen the colon or hind gut is found to be greatly enlarged and full of a light yellow or light brown excrement which the bee appears to be unable to void; the contents of the gut consist largely of undigested pollen grains, small particles of wax and innumerable bacteria.

It has been suggested that the disease is nothing more than a stoppage of the bowel, but the accumulation may be accounted for by the fact that the bee normally voids its excrement during flight, so that when it loses its power of flight the contents of the bowel remain and accumulate. All the internal organs of a diseased bee

appear natural to the eye and also when examined microscopically, with the exception of the chyle stomach, which is frequently found to have lost its pinkish colour and to be greyish with dark contents; it is also much more fragile than normally, and frequently ruptures when the digestive organs are removed from the body. Under the microscope it is found that the chyle stomach in these cases have undergone degenerative changes, and that the lining membrane is either stripped off from the muscular coat or is only loosely attached to it. In the healthy bee the chyle stomach is generally free from bacteria, but in diseased specimens they may be present in large numbers. Among the bacteria in many of the bees that have been examined a short oval bacillus is found to be present, which stains deeply at both ends with any of the ordinary dyes with a band of unstained cytoplasm in the centre. From its resemblance to the bacillus of plague this has been named the *Bacillus pestiformis apis*. This organism may frequently be found to have penetrated between the cells of the lining membrane of the chyle stomach and to be present in large numbers in the loosened tissue behind the secreting cells. It has been found present in about 60 per cent. of all the bees affected with this disease which have been examined.

The bacillus is not easily cultivated from the tissues of the bee as other organisms which are always present, particularly those of the *subtilis* family, grow more rapidly and prevent its development. It appears highly probable that this organism is the cause of the disease, but up to the present time no infection experiments have been successful in producing the complaint in healthy stocks, so that its relation to the disease cannot be said to be proved.

From the Isle of Wight the disease, during the last two years, has spread to the mainland, and has been noticed in Hants, Sussex, Surrey, Dorset, Berks., Bucks, Hertford, and Essex. It does not appear to be quite so virulent as it was in the Isle of Wight, where every old stock which existed before the outbreak has perished. Isle of Wight bee-keepers found that the first hives in an apiary which took the infection were those of the native bee, and although they ultimately became affected and perished, yet the Italian and hybrid stocks resisted longer than the native ones. In a few instances stocks badly affected in the Spring appeared to improve and get stronger during the Summer, but eventually perished in the Autumn, thus showing that the apparent improvement was only due to the hatching out of young and healthy bees which replaced for a time the older ones which had perished, and that when breeding ceased the remaining bees succumbed in their turn. So far no means have been found to check the spread of the disease, and the only treatment

is to destroy the stock as soon as it is proved to be infected. Fortunately the infection does not appear to remain long after the bees are dead: some cases have been recorded in which a swarm was allowed to take possession of a hive soon after the stock previously inhabiting it had died of the disease, and without any steps having been taken to disinfect or even remove the dead bees. In these cases it was found that the swarm remained healthy for a considerable time, thus showing that the infection disappears rapidly after the bees are dead. This may be due to the fact that the *B. pestiformis apis* is a non-spore bearing organism which cannot exist for any length of time except in the digestive tract of the living bee. It is interesting to note that the larvae apparently escape infection, as it would be natural to suppose that the food they receive would be contaminated by the bees which feed them. The explanation of this is probably that the nursing bees are those most recently hatched, and these do not seem to become infected till after they have finished their nursing duties. That the queen escapes infection is probably due to the fact that she receives different food from that which the workers eat; this also explains why the drones usually escape, as they help themselves from the stores which do not seem to harbour the infection.

Since this disease has already spread to the counties which are nearest to the Isle of Wight, there is little room to doubt that it will spread still further, and probably cause great damage to the bee-keeping industry all over the country. It behoves all those who keep bees to be on the look out for the first appearance of the disease in their apiaries, and to destroy any stock which shows signs of infection. By this means alone will it be possible to prevent the disease from spreading to all parts of the country.

As has been already said this complaint seems less virulent than when it originally appeared in the Isle of Wight, and it is to be hoped that this decrease in virulence will be maintained and at the same time that bees will gradually develop their powers of resistance which will enable them to throw off the disease even if they have become infected.

THE FEEDING HABITS OF THE ROOK, *CORVUS FRUGILEGUS*, LINN.[1]

By

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CONTENTS.

"*Economic Ornithology, or the study of the inter-relation of birds and agriculture, and an investigation of the foods, habits and plants, is an untrodden and promising field that lies open for investigation by the English agricultural scientist.*"

"*I question whether there exists in England a scientific ornithologist who has studied economic ornithology from an agricultural standpoint.*"

EARL CATHCART, *The Times*, May 16th, 1891.

I.—INTRODUCTION.

1. *Scope of the Inquiry.*

In September, 1908, I was invited by the Council of the Land Agents' Society to undertake an inquiry upon the feeding habits of the Rook.

Farmers, on many estates, had long complained of serious depredations and consequent losses due to this bird, whilst, on the other hand, its value to the agriculturist was continually being put forward in the agricultural Press.

Not a few members felt that the matter was sufficiently important for the subject of a careful inquiry, for it seemed very

[1] Report to the Council of the Land Agents' Society upon the Feeding Habits of the Rook, by Walter E. Collinge, M.Sc., F.L.S., F.E.S., Honorary Consulting Zoologist of the Society. Presented to the Council, April 1st, 1910.

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desirable that some definite decision should be arrived at respecting the economic status of this bird,[1] and further that the conclusions should be based upon information obtained from all parts of England, and extending over a period of at least twelve months.

For some time previous to this invitation I had given considerable attention to the subject of the food of various British birds,[2] and had data for fifty-eight *post-mortem* examinations of the stomach contents of the rook.

Mr. Douglas T. Thring[3] had similar data I found for 141 specimens killed on one estate at intervals of a few days throughout one whole year—1908.

In the present inquiry I have examined 631 stomachs, making a total of 830, the largest number of *post-mortems* of the rook which have ever been put on record in this country.

The object, therefore, of the present report is:—

a.—To set forth in detail an account of the stomach contents of the rooks examined from January 11th, 1909, to January 21st, 1910, from the various counties of England and Wales, and

b.—After considering the evidence offered by these and other specimens mentioned above, to recommend what measures should be taken respecting this bird on the landed estates of this country, in order to safeguard the interests of agriculturists and others.

In carrying out this interesting inquiry I have placed myself under many obligations to a large number of members of the Land Agents' Society, to all of whom I offer my sincere thanks for the very valuable help they have so willingly rendered, and without whose hearty co-operation this inquiry would have been impossible; especially must I mention the name of Mr. Douglas T. Thring.

To the Society's late Secretary, Mr. Cyprian R. Knollys, I wish to express my great thanks for the admirable and speedy manner in which he appointed the forty-five correspondents, and for many other kindnesses rendered during this inquiry.

Finally I desire to express my thanks to my two assistants, Messrs. F. W. Crispe and J. W. Shoebotham, whose loyal co-operation has lightened an otherwise heavy task.

2.—*Area covered by the Inquiry.*

For the purposes of this inquiry, the North, East and West Ridings of Yorkshire, and North and South Wales have each been regarded as counties. The inquiry has therefore extended over

[1] *Vide* letter from Douglas T. Thring, Journ. L. A. Soc. 1908, vol. vii, p. 444.

[2] On the Preservation of Wild Birds. Rpt. Inj. Insects and other Animals for 1905, pp. 45-52.

[3] Journ. L. A. Soc., 1909, vol. viii, p. 351.

forty-one counties of England and Wales, the specimens having been forwarded by forty-five members as set forth below:—

The only counties not represented are those of Derbyshire and Middlesex.

County.	Agent.	Landowner.
Bedfordshire	H. G. Papillon	Sir Julius Wernher.
Berkshire	W. Crossland	Sir Alexander Henderson.
Buckinghamshire	C. H. G. Harrison	The Earl of Rosebery, K.G.
Cambridgeshire	H. J. Garrod	The Exors. of Col. McCalmont.
Cheshire	Hon. J. E. Cross	Lt.-Col. Hubert C. Leigh.
Cornwall	C. I. L. Allix	The Earl of St. Germans.
Cumberland	W. Little	
Devonshire	C. Gerald Eve*	The Rev. W. Pollexfen Bastard.
Dorsetshire	G. Hastings Bostock	Lord Wolverton.
Durham	D. W. Meiklejohn	The Marquis of Londonderry, K.G.
Essex	E. A. Ruggles-Brise	A. W. Ruggles-Brise, Esq.
Gloucestershire	G. F. C. Hamilton	Hugh Andrews, Esq.
Hampshire	J. E. Thorold	Sir George Cooper.
Herefordshire	F. W. Herbert	General E. H. Clive.
Hertfordshire	J. C. McCowan	The Marquis of Salisbury.
Huntingdonshire	J. Bell	The Duke of Manchester.
Kent	G. A. M. Levett	F. D. Brockman, Esq.
Lancashire	J. J. Hornby	The Earl of Derby, K.G.
Leicestershire	Hon. H. R. Scott	The Duke of Rutland.
Lincolnshire	H. G. Atkinson Clark	The Countess Dowager of Carnarvon.
Norfolk	J. M. Wood	The Earl of Leicester.
Northamptonshire	Douglas T. Thring	The Duke of Buccleuch, K.G.
Northumberland	Sir Francis E. Walker	The Duke of Northumberland, K.G.
Nottinghamshire	A. E. Elliott	The Duke of Newcastle.
Oxfordshire	C. A. Wykeham-Martin	W. A. Wykeham-Musgrave, Esq.
Rutlandshire	P. C. Chichester	The Earl of Gainsborough.
Shropshire	C. H. B. Cane	Lord Harlech.
"	H. W. Fell	Capt. Heywood-Lonsdale.
Somersetshire	C. E. O. Wilkinson	George A. Gibbs, Esq.
Staffordshire	Walter Marchant	The Earl of Bradford.
Suffolk	Cecil S. Joy	Sir F. E. S. Adair, Bart.
Surrey	J. F. S. Mellor	The Duke of Northumberland, K.G.
Sussex	Lt.-Col. E. J. Mostyn	The Duke of Norfolk, E.M., K.G.

*E. T. Haslehurst, from November 1st.

County.	Agent.	Landowner.
Warwickshire ..	W. W. Hutton ...	Lord Willoughby de Broke
Westmorland ...	G. Aitchison ...	S. H. le Fleming, Esq.
Wiltshire	G. H. Aitken ...	The Marquis of Bath.
,, ...	E. A. Rawlence ..	E. F. B. Wingfield Digby, Esq.
Worcestershire ...	W. T. Meyrick ...	E. V. Wheeler, Esq.
Yorkshire, E. Riding	E. W. Thompson ..	Lord Wenlock.
,, N. Riding	F. W. Hall ...	The Marquis of Zetland.
,, W. Riding	L. C. Paget ...	The Earl of Harewood.
Wales, North ..	W. F. Addie ..	The Earl of Powis.
,, ,, ...	G. B. Bovill ...	Mrs. Wynne Finch.
,, South ..	G. Lipscomb ..	Miss Talbot.
,, ,, ..	P. Wilkinson ...	The Earl of Lisburne.

3. *Specimens Received.*

It was desired that each correspondent should, as far as practicable, forward one bird every fortnight, together with a form of particulars (see Appendix B).

The number of birds actually received was six hundred and thirty-one, as follows:—

County.	Months.						
	Jan.	Feb.	Mar.	Apl.	May	June	July
Bedfordshire	1	1	2	—	3	1	—
Berkshire	—	1	2	2	1	1	2
Buckinghamshire ...	—	2	2	2	2	2	3
Cambridgeshire ...	—	2	2	2	3	—	—
Cheshire	1	—	3	1	2	—	1
Cornwall	—	2	2	2	2	1	2
Cumberland	—	1	2	3	2	2	2
Devonshire	1	2	—	—	—	—	1
Dorsetshire	—	2	2	—	—	—	—
Durham	2	2	2	1	2	2	—
Essex	—	—	2	2	2	2	1
Gloucestershire ..	—	2	2	2	2	—	—
Hampshire	—	2	1	1	1	1	—
Herefordshire	1	1	3	1	1	—	—
Hertfordshire	1	2	2	2	3	2	2
Huntingdonshire ...	—	—	2	2	2	2	—
Kent	—	—	2	—	—	—	—
Lancashire	—	2	2	3	2	—	1
Leicestershire	—	5	—	—	—	—	—
Lincolnshire	—	1	1	1	—	—	—
Norfolk	—	2	2	2	—	1	1
Northamptonshire ...	1	2	2	2	3	2	2
Northumberland ...	—	1	2	1	1	1	2
Nottinghamshire ...	—	2	3	2	2	2	—
Oxfordshire	1	1	3	1	1	—	1
Rutlandshire	1	1	2	1	2	—	1
Shropshire	—	1	4	4	2	3	1
Somersetshire	1	—	—	3	2	1	—
Staffordshire	1	2	2	2	2	—	—
Suffolk	1	2	1	3	2	2	2
Surrey...	2	2	2	2	3	1	1
Sussex	—	1	1	1	—	—	1
Warwickshire	1	1	3	2	2	2	2
Westmorland	—	2	2	2	1	1	2
Wiltshire	—	3	6	4	5	6	5
Worcestershire	—	1	2	3	—	—	—
Yorkshire, E. Riding ...	1	3	2	—	—	—	2
,, N. Riding ...	1	1	1	2	1	1	1
,, W. Riding ...	—	4	1	3	2	2	2
Wales, North	—	2	1	2	1	1	—
,, South	—	4	3	5	1	3	1
No. of Rooks received	18	68	81	74	63	45	42
No. of Counties represented	16	36	38	35	32	25	25

County.	Months.						
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan., 1910.	Total.
Bedfordshire	—	—	—	—	—	—	8
Berkshire	1	1	2	—	2	1	16
Buckinghamshire ...	2	2	2	2	2	—	23
Cambridgeshire ..	—	—	—	1	2	—	12
Cheshire	2	1	2	—	—	—	13
Cornwall	—	1	3	2	3	1	21
Cumberland	2	2	3	2	2	1	24
Devonshire	2	—	1	1	—	—	8
Dorsetshire	—	1	1	—	—	—	6
Durham	3	2	2	3	1	1	23
Essex	1	—	—	—	—	—	10
Gloucestershire	—	—	—	—	—	—	8
Hampshire	—	—	—	—	—	—	6
Herefordshire	—	2	1	1	1	1	13
Hertfordshire	2	2	2	2	2	1	25
Huntingdonshire ...	1	1	1	2	—	—	13
Kent	—	—	—	—	—	—	2
Lancashire	2	2	1	2	1	—	18
Leicestershire	—	—	—	—	—	—	5
Lincolnshire	—	—	—	—	—	—	3
Norfolk	—	—	—	—	2	1	11
Northamptonshire ...	1	3	1	2	—	—	21
Northumberland ...	—	2	—	1	2	1	14
Nottinghamshire ...	1	—	1	1	—	—	14
Oxfordshire	—	3	1	—	—	1	13
Rutlandshire	3	2	1	2	1	—	17
Shropshire	1	2	1	1	1	—	21
Somersetshire	—	—	1	1	—	—	9
Staffordshire	1	1	2	—	—	—	13
Suffolk	2	2	2	1	2	—	22
Surrey...	1	1	2	3	4	2	26
Sussex	2	—	1	—	—	—	7
Warwickshire	2	3	2	2	2	2	26
Westmorland	2	2	1	2	—	—	17
Wiltshire	5	2	4	3	3	3	40
Worcestershire	—	1	1	—	—	1	9
Yorkshire, E. Riding ...	2	2	2	2	—	1	17
„ N. Riding ..	1	1	1	1	1	—	13
„ W. Riding ...	1	1	1	1	1	—	19
Wales, North	—	—	—	—	—	—	7
„ South	2	2	2	2	2	2	20
No. of Rooks received	45	47	48	43	37	20	631
No. of Counties represented	25	27	30	25	20	15	

Of these, three hundred and two were male birds and three hundred and twenty-nine female. The heaviest specimen weighed 21 ounces, the lightest 12 ounces, the average being 15½ ounces.

In eighty-one specimens the gizzards, when opened, were found to be empty, or contained a little grit only.

Without exception, all specimens were examined when fresh. The average time between being shot and dissected was thirty-two hours, in a few cases seventeen, and in two cases three days, due to the birds having fallen out of the boxes in the post, or the label having become detached. One specimen only has been lost in the post, and this occurred during the Christmas week.

As to the increase or otherwise in the different localities, eight members record an increase, eleven a slight decrease, two of which were due to the snowstorm of April 25th and 26th, 1908, when nearly all the young birds were destroyed; and twenty-four state that they have not observed any change in the numbers during the past few years.

The numbers at present in the various districts are commented upon by forty-three members; four of whom report the birds to be very abundant, thirty-four state abundant, and five not abundant.

Out of the forty-five replies only six state that the rooks are regularly shot each spring, but as this information was not definitely asked for, possibly the practice is carried out on other estates.

II.—The Rook in Relation to Agriculture.

1.—*Nature of its Food.*

It has generally been supposed that the food of the rook consists very largely of beetles, insect larvae, and earth-worms. A well-known ornithologist, the Rev. F. O. Morris, presented the following calculation before the "Wild Birds Protection Committee of the House of Commons of 1873": "A rook," he states, "requires at least one pound of food in a week, and of this nine-tenths is insects and worms. A rookery of 10,000 rooks will consume in one year 209 tons of worms, insects, and their larvae."

Saunders[1] states: "The food consists chiefly of insects and their larvae, but practically the rook will eat anything."

Other writers have made similar statements, but without any convincing evidence, so far as I am aware.

The rook, like many other birds, such as the thrush, starling, blackbird, etc., will destroy large numbers of beetles and insect larvae, but, as I have elsewhere pointed out,[2] "there are certain

[1] Illustrated Manual of British Birds, 2nd ed. 1899, p. 248.

[2] On the Preservation of Wild Birds. Rpt. Inj. Insects and other Animals for 1905, p. 45.

species of birds which are distinctly beneficial to the farmer, fruit grower, and gardener, if not allowed to become too numerous, but as soon as their numbers exceed a certain limit they become equally injurious, and cannot be regarded as other than enemies."

The nature of a bird's food must not be judged from a few specimens from one particular district, shot at one particular period of the year. Any conclusion based upon the information such investigations may reveal are sure to be misleading. The collection of this information must extend over a wide area and throughout all the months of the year. Further, great care is necessary in examining the stomach contents.

I need scarcely point out that where there is an unusual increase in a species over a series of years, there is usually a change in the food-habits, and this is nowhere more patent than in the case of the species here under consideration.

2.—*Life-History, Habits, etc.*

Few birds are better known than the rook, partly owing to the fact of its living in flocks, and also that it usually selects for its breeding places a situation close to human habitation.

In some localities it has undoubtedly rapidly increased during the last ten years; this is particularly so in Scotland, where it is said to destroy eggs on a large scale.

During the autumn months there is a large migration from the Continent on our east coast, and a return migration has been noted in the early spring.

The nest is usually built about the middle of March, but in some localities the birds have been observed building both earlier and later. Tall trees are usually selected, but sometimes firs, pollard-willows and even bushes have been chosen, and occasionally chimney-tops and church spires.

The nest consists of twigs and turf, lined with roots and straw. Here the three to five bluish-green eggs, blotched and streaked with olive-brown, are laid.

Breeding commences when the birds are nearly two years old.

III.—Nature of Food during 1908 and 1909.

In the following pages I have briefly summarised the nature of the food under different headings and the different months.

1.—*Vegetable Food.*

Grain.—The bulk of the food taken from the gizzards of the 631 rooks recorded in this report consisted of grain. Wheat and other grain was in the greatest abundance, it occurring in 320 cases.

Other Seeds.—Very few seeds were found amongst the stomach contents. In twelve there were a few seeds of charlock and dock, and in sixteen various species of knot grass, goose grass, etc.; whilst occasionally those of the broad bean occurred. In all, seeds were present in only 39 cases.

Fruits.—Remains of fruit were found in 84 cases; this consisted mainly of acorns, but in a few cases red currants and gooseberries were found.

Roots.—In 36 cases only were roots present, and in 80 per cent. these were grass roots, the remainder being potatoes.

Miscellaneous Vegetable Matter.—Sixty-two gizzards contained miscellaneous vegetable matter not identifiable.

2. *Animal Food.*

Throughout the whole of this inquiry I have been astonished at the little animal food found in the gizzards, which averages *in the twelve months* only 15 per cent. of the total food contents of the gizzards.

Beetles (*Coleoptera*). In 116 cases beetles or their larvae were present.

Flies (*Diptera*).—Dipterous larvae occurred in only 6 cases.

Butterflies and Moths (*Lepidoptera*).—In 15 gizzards larvae of Lepidoptera were present.

Aphids, Plant Bugs, etc. (*Hemiptera*). In only a single case was this order of insects represented.

Other Insects.—Seven gizzards containing bees or wasps.

Millipedes.—These were found in 6 cases.

Other Animal Matter.—In addition to the animal matter found and mentioned above, the bodies of four long-tailed field mice, part of the small intestine of a rat (?), and a young rabbit, and eight young birds, five of which were undoubtedly blackbirds, were found.

In seven gizzards there were bits of egg shell, in five cases these were undoubtedly pheasant eggs, in one a blackbird's, and the remaining one was unidentifiable with certainty, but probably it was that of the pheasant.

Earthworms or their cocoons were present in twenty-seven cases.

Miscellaneous Food.—Pheasant food and household scraps, e.g., bread, potato skins, bacon rind, etc., was present in 15 cases.

To summarise, of the 631 rooks, 70 per cent. of their food consisted of grain, 15 per cent. of seeds, fruits, roots, and miscellaneous vegetable matter; 4 per cent. of wireworms, 4 per cent. of other insects (mostly injurious), 1 per cent. millipedes, 2 per cent. earthworms, and 4 per cent. miscellaneous food. Adding these to the 141

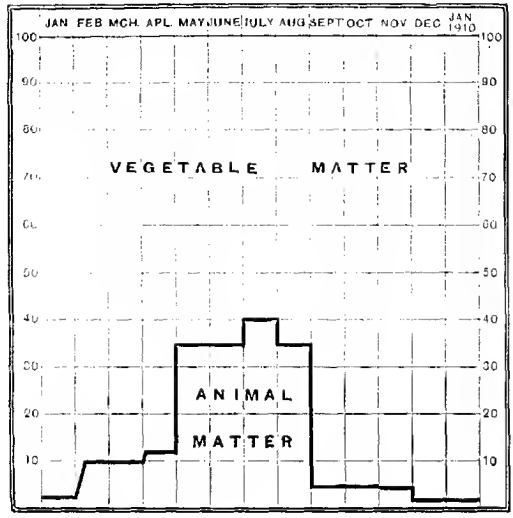
rooks recorded by Mr. Douglas T. Thring, and the fifty-eight specimens previously dissected by myself, the results may be tabulated as follows:—

					Total.
No. of Rooks	631	58	141		830
Grain	70	65			
Seeds, fruits, roots, and miscellaneous vegetable matter ...	15	10	53		71%
Wireworms	4				
Other insects	4	6	30		15%
Millipedes	1	1			
Earthworms	2	12	17		10·5%
Miscellaneous Food (eggs, young game, field mice, etc.) ...	4	6			3·5%

3.—*Monthly Register.*

In setting forth the details of the food contents of the gizzard for each month, the variety of vegetable matter is placed in order of the greatest percentage. The percentages (see Table A) have been calculated as regards bulk.

Month.	No. of Birds.	Grain.	Other Seed	Fruits.	Roots.	Mell. Veg. Ma	Coleop.	Diptera	Lepidop.	Hemiptera.	Other Insects.	Milligedes	Other Animal Matt	Mell. Food	Percentage Vegetable Ma	Percentage Animal Matt	Remarks.
1909.																	
January	18	5	2	11	2	2	5	0	0	0	0	1	5	1	98	2	Very little food in gizzards.
February	68	24	4	21	2	6	7	0	0	0	0	1	7	1	90	10	17 empty. Very little food in gizzards, average about $\frac{1}{3}$rd.
March	81	30	2	15	5	16	1	0	1	0	0	0	6	0	90	10	17 empty. Gizzard average $\frac{1}{2}$ full.
April	74	38	4	5	3	12	7	0	3	0	0	2	9	3	88	12	7 empty. Gizzard generally full.
May	63	24	1	1	1	4	20	3	6	0	4	0	13	2	65	35	12 empty. Gizzard generally full.
June	45	12	6	2	3	3	13	2	2	0	1	1	7	2	65	35	7 empty. Gizzard generally full.
July	42	14	6	0	6	7	20	1	2	1	2	1	10	2	60	40	4 empty. Gizzard generally full.
August	45	27	3	0	3	1	16	0	0	0	0	0	3	4	65	35	7 empty. Gizzard generally full.
September	47	41	0	0	3	0	9	0	0	0	0	0	0	0	95	5	4 empty. Gizzard generally full.
October	48	39	10	0	3	5	10	0	0	0	0	0	3	0	95	5	1 empty. Gizzard generally full.
November	43	33	1	9	3	3	5	0	0	0	0	0	0	0	96	4	1 empty. Gizzard generally full.
December	37	23	0	12	1	3	1	0	1	0	0	0	2	0	99	1	2 empty. About $\frac{3}{4}$ full.
1910.																	
January	20	10	0	8	1	0	2	0	0	0	0	0	0	0	99	1	2 empty. About $\frac{3}{4}$ full.
	631	320	39	84	36	62	116	6	15	1	7	6	65	15	85	15	



January.—The first bird was received on January 16th, and seventeen more came in during the remainder of the month.

Generally speaking, but little food was contained in the gizzard. The contents were as follows:—

Acorns, oats, wheat, grass roots, bits of grass, 2 grains of maize, bits of bread and potatoes.

Part of the body of a bird (blackbird?), 8 wireworms, 2 click beetles, 5 green rose chafers (*Cetonia aurata*, Linn.), 8 black vine weevils (*Otiorhynchus sulcatus*, Fabr.), bits of 2 beetles, 5 earthworms, 7 cocoons of earthworms, bits of 2 centipedes.

Two of the gizzards, containing very little food, were highly inflamed.

February.—Number of birds received, 68. The gizzards of 17 were empty, and the remainder were about one-third full.

The contents were as follows:—

Bits of acorns, wheat, oats, maize, meal, broken seeds, cotton cake, grass roots, bits of potatoes, seeds of grass.

Body of long-tailed field mouse (*Mus sylvaticus*, Linn.).

Remains of 10 beetle larvae, 4 wireworms, 6 click beetles, remains of 8 beetles, 1 spider, 3 millipedes, 2 earthworms, 28 earthworm cocoons, and 1 shell of snail (*Helix hispida*).

March.—Number of birds received, 81. The gizzards of 17 were empty, and the remainder were about half full.

The contents were as follows:—

Acorns, wheats, oats, maize, grass roots, seeds of pheasant food, miscellaneous vegetable matter, bits of raw potato, bread.

One mouse and part of the small intestine of a rat (?)

Remains of 3 beetles, one larva of turnip dart moth (*Agrotis segetum*, Schiff.), 2 earthworms.

April.—Number of birds received, 74. The gizzards of 7 were empty, and the remainder were full.

The contents were as follows:—

Newly sown wheat, oats, grass roots, and miscellaneous vegetable matter.

Part of the small intestine of a young rabbit, bodies of 2 long-tailed field mice (*Mus sylvaticus*, Linn.), bodies of two young birds (blackbirds?), bits of yolk of egg, and egg shells of blackbird.

Remains of 4 beetles, 24 wireworms, 3 larvae of turnip dart moth (*Agrotis segetum*, Schiff.), 4 millipedes (*Polydesmus complanatus*, Linn.), 4 earthworms, and 22 earthworm cocoons.

May.—Number of birds received, 63. The gizzards of 12 were empty, and the remainder generally full.

The contents were as follows:—

Newly-sown wheat and oats.

Bodies of two young blackbirds (probably taken from eggs), parts of bodies of two other small birds. Bits of pheasant eggs found in three birds.

Remains of 20 beetles, 60 wireworms, 2 dor beetles, remains of 13 lepidopterous larvae, 74 larvae of winter moth (*Cheimatobia brumata*, Linn.), 5 larvae of turnip dart moth (*Agrotis segetum*, Schiff.), 1 earwig (*Forficula auricularia*, Linn.), 30 leather jacket grubs, 29 earthworms, remains of two millipedes, 1 bee.

June.—Number of birds received, 45. The gizzards of 7 were empty, and the remainder generally full.

The contents were as follows:—

Peas, potatoes, beans, maize, wheat, grass roots, gooseberries, oats.

13 wireworms, 20 click beetles (*Agriotes lineatus*, Linn.), 2 larvae of cockchafer (*Melolontha vulgaris*, Fabr.), 1 green rose chafer (*Cetonia aurata*, Linn.), 40 dung beetles (*Aphodius fimetarius*, Linn.), remains of 17 black ground beetles (*Pterostichus madidus*, Fabr.), 9 smaller June bugs (*Phyllopertha horticola*, Linn.), 7 June bugs (*Rhizotragus solstitialis*, Linn.), 17 not identifiable, 139 lepidopterous larvae (mostly *Agrotis* sp.), puparia of 30 blow-flies

(*Calliphora vomitoria,* Linn.), and 4 larvae of same, 66 leather jacket grubs, 2 millipedes (*Julus pulchellus,* Koch), 13 earthworms, egg-shells in 3 birds.

July.—Number of birds received, 42. The gizzards of 4 were empty, and the remainder generally full.

The contents were as follows:—

Peas, potatoes, wheat, turnip plants, seeds, maize, oats, grass roots, miscellaneous vegetable matter.

Bodies of 5 young birds. Egg shells in two birds.

Two cockchafer larvae, 39 click beetles, 4 wireworms, 7 beetles (*Geotrupes* sp.), remains of 18 dung beetles (*Aphodius fimetarius,* Linn.), 12 black ground beetles (*Pterostichus madidus,* Fabr.), 16 not identifiable, 1 beetle larva, 4 lepidopterous larvae, one earwig, one plant bug (*Pentatoma* sp.), one spider, one millipede (*Polydesmus complanatus,* Linn.), 3 earthworms.

August.—Number of birds received, 45. The gizzards of 7 were empty, and the remainder generally full.

The contents were as follows:—

Oats, wheat, peas, miscellaneous vegetable matter.

Body of one young bird and 1 long-tailed field mouse.

Remains of about 200 beetles, probably many more were eaten. The number was arrived at by counting the legs and jaws; it was impossible to identify the species with any certainty. Some were undoubtedly the black ground beetle (*Pterostichus madidus,* Fabr.), but the greater proportion were smaller species and a few *Geotrupes stercorarius.*

September.—Number of birds received, 47. The gizzards of 4 were empty, and the remainder were generally full.

The contents were as follows:—

Wheat, oats, maize, miscellaneous vegetable matter, potatoes.

Beetle remains in 9 gizzards, 4 dung beetles (*Aphodius fimetarius,* Linn.), 14 dor beetles (*Geotrupes* sp.?), 2 black ground beetles (*Pterostichus madidus,* Fabr.), and 1 wireworm.

October.—Number of birds received, 48. The gizzard of 1 was empty, and the remainder were generally full.

The contents were as follows:—

75 per cent. wheat, maize, acorns, grass roots, and miscellaneous vegetable matter.

Remains of 8 beetles in 6 gizzards, 2 green rose chafers (*Cetonia aurata,* Linn.), 2 click beetles, 1 black ground beetle (*Pterostichus madidus,* Fabr.), and 5 earthworms.

November.—Number of birds received, 43. The gizzard of 1 was empty, and the remainder were generally full.

The contents were as follows:—

Wheat, barley, maize, few acorns, miscellaneous vegetable matter, and grass roots.

Remains of beetles in 5 gizzards, viz., 1 dor beetle and remains of 4 others.

December.—Number of birds received, 37. The gizzards of two were empty, and the remainder averaged three-quarters full.

The contents were as follows:—

Wheat, maize, barley, acorns, miscellaneous vegetable matter, and grass roots.

Two dung beetles (*Aphodius fimetarius*, Linn.), and 1 lepidopterous larva.

January, 1910.—Number of birds received, 20. The gizzards of two were empty, and the remainder averaged threequarters full.

The contents were mainly wheat, a few acorns, and grass roots. In two there were remains in each of a single beetle.

IV.—Parasites of the Rook.

In the six hundred and eighty-nine *post mortems* it is somewhat surprising that not a single entozoic parasite was found. Knowing how difficult it sometimes is to detect the presence of certain forms in freshly killed birds, special care was adopted.

The ectozoic parasites were not numerous as regards the number of species. Three species of lice (*Mallophaga*) and two species of mites (*Acarina*) were found.

The former were most plentiful during the months of March, April and May, and were present in lesser numbers throughout the year.

In no case was it noticed that the rooks suffered from these parasites, although in April and May scores of lice were to be found on a single bird.

In addition to the above true parasites, in single cases there were found an Aphid, a Psocid, and a bug (*Homoptera*).

V.—Summary and Conclusion.

The results of this investigation, embracing a consideration of the stomach contents of 830 rooks, shot throughout the years 1908-9, throughout England and Wales, show:—

1. That 67.5 per cent. of the food of the rook consists of grain; if to this we add that of roots and fruits, the percentage is raised to 71 per cent.

2. The animal food content was only 29 per cent., of which quite one-third must be reckoned against the rook.

3. There is ample evidence to show that with the present large number of rooks, a grain diet is preferred.

4. So far as the evidence of this inquiry shows, the rook is not a particularly beneficial bird to the agriculturist, although its usefulness might be considerably increased were it fewer in numbers.

Recommendations.

In writing of the birds that injure grain in the United States of America, Mr. F. E. L. Beal[1] states "If it be admitted that birds do not as a rule display an inordinate appetite for grain, the question naturally arises: What is the cause of the tremendous ravages they sometimes commit? Both stomach examination and field observation point to the same answer: Too many birds of the same or closely allied species are gathered together within a limited area."

No words could be more pertinent than these in respect to the inquiry in hand, in short *we have too many rooks*, indeed one might go further and state that we have *far too many of a number of species* which are distinctly destructive to cereal and root crops, game, etc.

The only recommendation I have to make is to suggest that Land Agents and others should at once proceed to systematically reduce this number and hold it in check.

[1] Year-book of the U.S. Dept. Agric., 1897, p 353.

VII.—APPENDICES.*

APPENDIX A.

THE LAND AGENTS' SOCIETY.

Inquiry *re* the Food of Rooks.

WALTER E. COLLINGE, M.Sc., F.L.S.,
Hon. Consulting Zoologist, BERKHAMSTED.

Senders' Name ....

Address

Is the district wooded?

Are the fields bounded by hedges, dykes, or walls?

General character of neighbouring land

What crops are grown in the locality?

Is the species abundant in the locality?

Has there been any increase or decrease during the past few years?

* Through an oversight, I omitted, in the original Report, to acknowledge the source of these Schedules. Permission was very kindly granted me by the Economic Ornithological Committee of the British Association, and I here tender them my grateful thanks.

APPENDIX B.

THE LAND AGENTS' SOCIETY.

Inquiry *re* The Food of Rooks.

WALTER E. COLLINGE, M.Sc., F.L.S.,
Hon. Consulting Zoologist, BERKHAMSTED.

PARTICULARS OF SPECIMEN.

Sender's Name.....

Date on which Specimen was killed .....

Hour of the day when killed

Exact locality where Specimen was obtained ....

.....

Character of land upon or near which it was shot .....

.....

Is the land well cultivated? .....

.....

What was the bird doing when shot (feeding, flying, etc.) .....

.....

Weather ..... *Type of Weather prevailing*

Was the Specimen a member of a flock? if so, state the approximate size of the flock

.....

Date and hour of despatch .....

.....

General Remarks.....

Not to be filled up by Correspondent.

Specimen received—Date ..... *Hour* .....

Crop and Gizzard Removed—Date ....

Reference No. ..... *Weight of Bird* .....

By whom received ....

By whom dissected and food tabulated ....

Remarks :—

NOTE.

On the Feeding Habits of the Common Earwig, *Forficula auricularia*, Linn.

On page 2 of Dr. Malcolm Burr's recently published work on the Dermaptera of British India, it is stated that "earwigs are frequently accused of damaging flowers by devouring the petals; has this been proved?"

In the literature on economic entomology there are numerous references to the depredations of these insects, but some notes on recent personal observations may possibly not be without interest.

In the spring of 1908 I had planted against a wall a honeysuckle (*Lonicera periclymenum*), and about the middle of June I noticed that many of the flowers were being destroyed. Upon examination it was found that one or more earwigs were present in each damaged flower, and in order to prove whether or not these insects were the culprits, certain branches on one side of the tree (the right-hand) were coated with a mixture of glue and carbolic, whilst those on the left-hand side were left untouched. By the middle of July not a single undamaged blossom remained on the unprotected side, whilst those on the opposite side were untouched. Further the bark on the left-hand side had been torn away, and the tree thereby greatly damaged.

Specimens collected from the damaged blossoms were killed, and a microscopic examination was made of the stomach contents. No particle of animal matter was found, but amongst the vegetable contents there was distinct evidence that the food had largely consisted of the blossoms of the honeysuckle.

Examples taken from a large red Dahlia give similar results, but here the vegetable matter was distinctly tinged with red.

Specimens examined regularly from June to the end of September gave the following results: from June to the second week in September only vegetable matter was traceable. In the latter part of the month animal matter commenced to appear, whilst in a few unearthed from between rockery stones in October animal matter only was present.

I am fully aware that earwigs frequently hide in flowers without damaging them, but if an undamaged dahlia flower be placed in a closed box with a few earwigs overnight and examined next morning, the nature and extent of the damage these insects commit will be very quickly apparent.

WALTER E. COLLINGE.

[JOURN. ECON. BIOL., June, 1910, vol. v, No. 2.]

REVIEWS.

Boyce, Rubert W.—Health Progress and Administration in the West Indies. Pp. xv + 328, 47 figs. and map. London: John Murray, 1910. Price 10s. 6d.

In the work before us, Prof. Boyce has given an extremely interesting account of the progress of sanitation and sanitary administration in the West Indies. The work, further, will serve, as the author remarks, as a small introduction to the history of yellow fever in the West Indies.

Prof. Boyce commences by giving a short account of the early history of yellow fever in the West Indies, tracing the subject through the eighteenth and nineteenth centuries, together with the old and modern views of the nature and mode of transmission of the disease. After pointing out some of the factors which have made the West Indies healthier, e.g., pipe-borne water supplies and education, he briefly summarizes the more important factors in the war against insect pests, the anti-larval Laws of the different islands, and the importance of exercising vigilance over trade routes and shipping.

Turning next to the outbreak of yellow fever in Barbadoes in 1907, the author states that had there been proper medical administration the disease would never have gained a footing. He characterizes the sanitary organization as out-of-date, "ancient and picturesque," "eminently respectable but shabby." The lack of registration of the causes of death, the need of district medical officers of health and the absence of regular sanitary reports, are, it is pointed out, all matters requiring attention, indeed the sanitary administration is tersely, but truly summed up by being described as "barbaric and primitive."

The situation when Prof. Boyce arrived in Barbadoes in March, 1909, is described as undoubtedly disclosing an extraordinary state of affairs—the total lack of a medical head for the colony. He spares neither the Legislative Council nor Government Officials, and if for no other reason his work will be welcomed as a fearless and outspoken condemnation of ignorance and laxity.

The book is well illustrated, and full of interest from cover to cover.

W. E. C.

Burr, Malcolm.—The Fauna of British India, including Ceylon and Burma. Edited by Dr. A. E. Shipley, F.R.S. Dermaptera (Earwigs). Pp. xviii + 217, x plts. and 17 text figs. London: Taylor and Francis, 1910.

Although a somewhat neglected Order, Dr. Burr in his introduction discusses a number of points in connection with the life-history and

structure of the Dermaptera, which cannot fail to arouse a renewed interest.

After reviewing the structure, he briefly discusses the determination of species, development, copulation, oviposition, ova, food, maternal care and geographical distribution. Brief as these sections are, they are full of interest, and our only regret is that they are not more fully treated of. As the author points out we have yet much to learn respecting the bionomics of this order of insects, and it is to be hoped that the publication before us will incite new observations and contributions.

One hundred and thirty-five species are enumerated for British India, which are classified under 5 families, 14 sub-families and 51 genera; the descriptions are clear and full, and the classification distinctly helpful. As the recognized authority on this order, the author has given us a valuable and an interesting addition to the literature, which will be welcomed by entomologists generally.

W. E. C.

CURRENT LITERATURE.

I.—General Subject.

Ballou, H. A.—Legislation in the West Indies for the Control of Pests and Diseases of Imported Plants. W.I. Bull., 1910, vol. x, pp. 197-234.

Boyce, R., and F. C. Lewis.—The Effect of Mosquito Larvae upon Drinking Water. Ann. Trop. Med. and Paras., 1910, vol. iii, pp. 591-594.

Britton, W. E.—The Official Entomologist and the Farmer. Journ. Econ. Entom., 1910, vol. 3, pp. 12-20.

Colcord, Mabel.—List of Publications of the Bureau of Entomology. U.S. Dept. Agric., Bur. of Entom., Circ. No. 76 rev., 1910, pp. 1-32.

Cotton, E. C.—A Constant Low Temperature Apparatus for Biological Investigations. Journ. Econ. Entom., 1910, vol. 3, pp. 140-145, plts. 6-8, 1 fig.

Felt, E. P.—Control of Flies and other Household Insects. N.Y. State Mus., Bull. 136, 1910, pp. 5-53, 34 figs.

Fiske, W. F.—Superparasitism: An Important Factor in the Natural Control of Insects. Journ. Econ. Entom., 1910, vol. 3, pp. 88-97, 1 fig.

Hewitt, C. Gordon.—Importance of Entomology in the Development of Canada. Evidence of Dr. C. Gordon Hewitt. Ottawa, 1910, pp. 17-54.

Howard, A. and G. L. C.—Studies in Indian Tobaccos. No. 1. The Types of *Nicotiana rustica*, L., Yellow Flowered Tobacco. Mem. Dept. Agric. India, Bot. Ser., 1910, vol. iii, No. 1, pp. 1-58, plts. i-xxv.

Sanderson, E. D.—The Relation of Temperature to the Growth of Insects. Journ. Econ. Entom., 1910, vol. 3, pp. 113-140, 21 figs.

A very interesting and valuable paper.

II.—Anatomy, Physiology, and Development.

Baunacke, W.—Abdominale Sinnesorgane bei *Nepa cinerea*. Zool. Anz., 1910, Bd. xxxv, pp. 484-489, 4 figs.

Becker, E. Zum Bau der Postantennalorgane der Collembolen. Zeit. f. wiss. Zool., 1910, pp. 327-399, T. xi, xii.

Hoppner, H.—Zur Biologie der Rubusbewohner. II. Die Konkurrenz um die Nistplätze. Zeit. wiss. Insecktenbiol., 1909, Bd. vi, pp. 93-97, 3 fign.

Meisenheimer, J.—Zur Ovarial transplantation bei Schmetterlingen. Zool. Anz., 1910, Bd. xxxv, pp. 446-450, 2 fign.

Regen, J.—Kastration und ihre Folgeerscheinungen bei *Gryllus campestris*, L. Zool. Anz., 1910, Bd. xxxv, pp. 427-432.

Rungius, H. Über eine Besonderheit des Larvendarmes von *Dytiscus marginalis*. Zool. Anz., 1910, Bd. xxxv, pp. 341-347, 3 fign.

Schmidt, H. Beitrag zur Biologie der Steinobst-Blattwespe (*Lyda nemoralis*, L.). Zeit. wiss. Insecktenbiol, 1910, Bd. vi, pp. 86-92, 3 fign.

Stevens, N. M. Note on Reduction in the Maturation of male Eggs in *Aphis*. Biol. Bull., 1910, vol. xviii, pp. 72-75, 5 figs.

III. General and Systematic Biology, and Geographical Distribution.

Annandale, N. A minute Hymenopterous Insect from Calcutta. Rec. Ind. Mus., 1909, vol. iii, pp. 299, 300, plt. xxiii.

Berlese, Antonio.—Acari Nuovi. Man. v-vi. Redia, 1910, vol. vi, pp. 199-234, T. xviii-xxi.

Berlese, Antonio.—Lista di nuove specie e nuovi generi di Acari. Ibid., pp. 242-271.

Cameron, P. Contribution to the Knowledge of the Parasitic Hymenoptera of Argentina. Trans. Amer. Entom. Soc., 1909, vol. xxxv, pp. 419-450, 4 plts.

Cockerell, T. D. A.—Some Bees of the Genus *Augochlora* from the West Indies. Proc. U.S. Nat. Mus., 1910, vol. xxxvii, pp. 489-494.

Cockerell, T. D. A.—New Dipterous Parasite of Bats. Canad. Entom., 1910, p. 59.

Cockerell, T. D. A.—A Link in the Evolution of the Bees. Nature, 1910 (May 12th), pp. 311, 312.

Crawford, D. L.—Thysanoptera of Southern California. II. Pomona Journ. Entom., 1910, vol. ii, pp. 149-152, 1 fig.

Anaphothrips longipennis is described as new.

Crawford, D. L.—Thysanoptera of Mexico and the South. II. Ibid., pp. 153-170, 8 figs.

The following new species are described: *Euthrips cephalicus*, *Dictyothrips reticulata*, *Thrips abdominalis*, *Phloeothrips raptor*, *Liothrips bakeri*, *L. meconnelli*, *Anthothrips variabilis*, and *Idolothrips angusticeps*.

Graham, W. M.—On new Species of West African *Culicidae*. Ann. Mag. N.H., 1910, vol. v (s. 8), pp. 264-273.

Hitchings, E. F.—The Unprecedented appearance of the Saddled-prominent (*Heterocampa guttivitta*). Journ. Econ. Entom., 1910, vol. 3, pp. 146-148.

Howard, L. O.—The Parasites reared or supposed to have been reared from the eggs of the Gypsy Moth. U.S. Dept. Agric., Bur. of Entom., Tech. Ser., No. 19, pt. i, 1910, pp. 1-12, 7 figs.

Hitherto no native American egg-parasites have ever been reared from the eggs of the Gypsy Moth since its introduction into the United States in the late sixties. The parasites here described were reared from eggs received from Japan, they include *Schedius kuvanae*, gen. et sp. nov., *Tyndarichus navae*, gen. et sp. nov., *Anastatus bifasciatus* (Fonsc.), *Pachyneuron gifuensis*, Ashmead, and *Atoposomoidea ogimae*, gen. et sp. nov.

Kelly, E. O. G.—Studies on the development of *Eupelmus allynii*, French, and *Stictonotus isosomatus*, Riley. Journ. Econ. Entom., 1910, vol. 3, pp. 202-204.

Massalongo, C.—Galle e simili produzioni anormali. Marcellia, 1909, vol. viii, pp. 133-141, 6 figs.

Pantanelli, E.—Un Eriofiide nuovo sull' Olivo. Marcellia, 1909, vol. viii, pp. 142-146, 4 figs.

Silvestri, F.—Contribuzione alla conoscenza dei Miriapodi dell' Uganda. Ann. Mus. Civ. Stor. Nat. Genova, 1910, ser. 3, vol. iv, pp. 457-478, 9 figs.

Silvestri, F.—Descrizioni preliminari di novi generi di Diplopodi. Zool. Anz., 1910, Bd. xxxv, pp. 357-364, 10 figs.

Silvestri, F.—Materiali per una revisione dei Diplopoda Oniscomorpha. Boll. Lab. Zool. R. Sc. Agric. Portici, 1910, vol. iv, pp. 181-220, figs. i-xxii.

Silvestri, F.—Metamorfosi del *Cybocephalus rufifrons*, Reitter, e notizie sui suoi costumi. Ibid., pp. 221-227, figs. i-vi.

Silvestri, F.—Introduzione in Italia d'un Imenottero indiano per combattere la mosca delle arance. Boll. Lab. Zool. R. Sc. Agric. Portici, 1910, vol. iv, pp. 228-245, figs. i-viii.

Silvestri, F.—Contribuzioni alla conoscenza degli insetti dannosi e dei loro sunbionti. I. Galerucella dell'olmo. Ibid., pp. 246-289, figs. i-xxv.

IV.—Agriculture and Horticulture.

Adcock, G. H.—Erinnse nf the Vine. Journ. Dept. Agric., Victoria, 1910, vol. viii, pp. 203-205, 3 figs.

Ainslie, G. G.—The Larger Corn Stalk-borer (*Diatroea saccharalis*, Fab.). U.S. Dept. Agric., Bur. of Entom., Cir. No. 116, 1910, pp. 1-8, 4 figs.

Bancroft, C. K.—Fungi causing diseases of Cultivated Plants in the West Indies. W.I. Bull., 1910, vol. x, pp. 235-268, 1 plt.

Burgess, A. F.—Some Insecticide Methods used in Combating the Gypsy Moth. Journ. Econ. Entom., 1910, vol. 3, pp. 38-42.

Burgess, A. F.—Notes on *Calosoma frigidum*, Kirby, a native beneficial insect. Journ. Econ. Entom., 1910, vol. 3, pp. 217-222.

Butler, E. J.—The Wilt Disease of Pigeon Pea and the Parasitism of *Neocosmospora vasinfecta*, Smith. Mem. Dept. Agric. India, Bot. Ser., 1910, vol. ii, No. 9, pp. 1-64, plts. i-vi.

Collinge, Walter E.—Collembola as Injurious Insects. Journ. Econ. Entom., 1910, vol. 3, pp. 204, 205.

Cooley, R. A.—Notes on Spraying Experiments for the Oyster Shell Scale in Montana. Journ. Econ. Entom., 1910, vol. 3, pp. 57-64.

Davis, J. J.—Insect Notes from Illinois for 1909. Journ. Econ. Entom., 1910, vol. 3, pp. 180-186, plts. 9-11.

Dean, W. H.—Some notes upon the Life-History and Habits of the Sorghum Midge (*Contarinia* (*Diplosis*) *sorghicola*, Coq.). Journ. Econ. Entom., 1910, vol. 3, pp. 205-207.

Essig, E. O.—The Natural Enemies of the Citrus Mealy Bug. I. Pomona Journ. Entom., 1910, vol. ii, pp. 143-146, 3 figs.

Essig, E. O.—The Genus *Pseudococcus* in California. Ibid., pp. 147, 148, 2 figs.

Felt, E. P.—Observations on the House-Fly. Journ. Econ. Entom., 1910, vol. 3, pp. 24-26.

Felt, E. P.—Spraying for the Codling Moth. Journ. Econ. Entom., 1910, vol. 3, pp. 172-176.

French, Junr., C.—A new Fruit Pest (*Heliothis armigera*, Hubn.). Journ. Vict. Dept. Agric., 1910, vol. viii, pp. 50-52, 1 fig.

Gillette, C. P.—New Sprays for the Codling Moth. Journ. Econ. Entom., 1910, vol. 3, pp. 29-32.

Gillette, C. P.—Some Insecticide Tests for the Destruction of *Aphididae* and their Eggs. Journ. Econ. Entom., 1910, vol. 3, pp. 207-210.

Grossenbacher, J. G.—Crown-rot, Arsenical poisoning and Winter Injury. N.Y. Agric. Exp. Stat., Geneva, N.Y., Tech. Bull. No. 12, 1909, pp. 367-411, 8 plts.

Harding, H. A., and W. J. Morse.—The Bacterial Soft Rots of Certain Vegetables. Pt. I. The Mutual Relationships of the Casual Organisms. N.Y. Agric. Exp. Stat., Geneva, N.Y., Tech. Bull. No. 11, 1909, pp. 251-287.

Headden, W. P.—Arsenical Poisoning of Fruit Trees. Journ. Econ. Entom., 1910, vol. 3, pp. 32-35.

Headlee, T. J.—Notes on the Corn Ear-worm. Journ. Econ. Entom., 1910, vol. 3, pp. 149-157, 4 figs.

Hertzog, P. H.—Notes on "Cigarette Beetle." Journ. Econ. Entom., 1910, vol. 3, pp. 198-202.

Hinds, W. E., and W. F. Turner.—Carbon di-sulphide Fumigation for the Rice Weevil in Corn. Journ. Econ. Entom., 1910, vol. 3, pp. 47-56, plts. 4, 5.

Jack, R. W.—The Potato Tuber Moth. Rhodesian Agric. Journ., 1910, vol. vii, pp. 1110-1114, 1 plt.

Jones, L. R.—The Bacterial Soft Rots of Certain Vegetables. Pt. II. Pectinase, the cytolytic enzyme produced by *Bacillus carotovorus* and certain other Soft-rot Organisms. N.Y. Agric. Exp. Stat., Geneva, N.Y., Tech. Bull. No. 11, 1909, pp. 289-368, 10 figs.

Kirk, T. W., and A. H. Cockayne.—Scale Insects in New Zealand. 17th Ann. Rpt. N.Z. Dept. Agric., 1909, pp. 273-285, 6 figs.

Kirk, T. W., and A. H. Cockayne.—The Pests and Diseases of New Zealand. Phormium. Ibid., pp. 286-289, 9 plts.

Laidlaw, W.—The Onion Eel-worm. Journ. Dept. Agric. Victoria, 1910, vol. viii, pp. 163-171, 5 figs.

Lefroy, H. M., and G. Evans.—Experiments in the Storage of Seed-potatoes. Agric. Journ. Ind., 1910, vol. v, pp. 19-28, plt. i.

Lounsbury, Chas. P.—Miscible Oils for Spraying. Agric. Journ. C. of G.H., 1910, vol. xxxvi, pp. 110-114.

McAlpine, D.—Irish Blight on Tomatoes. Journ. Dept. Agric. Victoria, 1910, vol. viii, pp. 48, 49, 2 figs.

Marcinowski, K.—Parasitisch und semiparasitisch an Pflanzen lebende Nematoden. Arb. Biol. Anst. Land u. Forstwirtsch, 1909, Bd. vii, pp. 1-192, 1 tav, 76 fign.

Norton, J. B. S.—Some Obscure Diseases of Peach. Journ. Econ. Entom., 1910, vol 3, pp. 228-236.

O'Kane, W. C.—Work on the Apple Maggot (*Rhagoletis pomonella*, Walsh.). Journ. Econ. Entom., 1910, vol. 3, pp. 169-172.

Parrott, P. J.—The Cherry Ermine Moth (*Hyponomeuta padella*, L.). Journ. Econ. Entom., 1910, vol. 3, pp. 157-161.

Parrott, P. J.—Concentrated Lime-sulphur mixtures. N.Y. Agric. Exp. Stat., Geneva, N.Y., Bull. No. 320, 1909, pp. 419-438.

Pierce, W. M.—Fumigation Studies. I. Pomona Journ. Entom., vol ii, pp. 139-142, 4 figs.

Rane, F. W.—Present conditions of the Gypsy and Brown Tail Moth Work in the Massachusetts. Journ. Econ. Entom., 1910, vol. 3, pp. 36-38.

Sanderson, E. Dwight.—Controlling the Black Fly in the White Mountains. Journ. Econ. Entom., 1910, vol. 3, pp. 27-29, plts. 2, 3.

Sanderson, E. D.—Insect Notes from New Hampshire for 1909. Journ. Econ. Entom., 1910, vol. 3, pp. 210-212.

Saunders, W.—Report of the Division of Entomology and Botany for the Year ending March 31, 1909. Ann. Rpt. Exp. Farms, 1908-9, Ottawa, 1910, pp. 37-64, 1 plt.

Scott, W. M., and A. L. Quaintance.—Control of the Brown-Rot and Plum Curculio on Peaches. U.S. Dept. Agric., Bur. of Entom., Circ. No. 120, 1901, pp. 1-7.

Severin, H. H. P.—The San Jose Scale and its Relation to Climatic Districts or Life Zones in Wisconsin. Journ. Econ. Entom., 1910, vol. 3, pp. 101-103, 1 fig.

Smith, John B.—*Amara avida*, Say, as a Strawberry Pest. Journ. Econ. Entom., 1910, vol. 3, pp. 97-99, 8 figs.

Smith, John B.—Insects Injurious to Strawberries. Agric. Exp. Stat., New Jersey, Bull. 225, 1909, pp. 1-37, 11 figs.

Smith, Ralph E.—Report of the Plant Pathologist. Agric. Exp. Stat. Berkeley, Cal., Bull. No. 203, 1909, pp. 1-63, 23 figs.

Theobald, Fred. V.—Report on Economic Zoology, for Year ending April 1st, 1909. Pp. 110, 34 plts. Ashford: Headley Brothers, 1910. Price 2s. 6d.

This report is on the lines of those we have previously noticed. No new pests of special interest are reported. There is a short account of the Sheep Nasal Fly, details of a series of trials with nicotine sprayfluids, and experiments on greases and grease-banding.

Not the least valuable portion of the report is the account of a mosquito plague at Woking, and some notes on the British mosquitoes, This includes a list of the British *Culicidae*, a synonymic list, a synoptic table, and notes.

van Slyke, L. L., and others.—A Chemical Study of the Lime-sulphur Wash. N.Y. Agric. Exp. Stat., Geneva, N.Y., Bull. No. 319, 1909, pp. 383-418.

Washburn, F. L.—1. Further Observations on *Empoasca mali*. 2. Notes on *Papaipema nitela* and *P. cataphracta*. Journ. Econ. Entom., 1910, vol. 3, pp. 162-168.

Webster, F. M.—The Clover Root-borer (*Hylastinus obscurus*, Marsham). U.S. Dept. Agric., Bur. of Entom., Circ. No. 119, 1910, pp. 1-5, 4 figs.

Webster, F. M., and G. I. Reeves.—The Western Grass-stem Sawfly (*Cephus occidentalis*, Riley and Marlatt). U.S. Dept. Agric., Bur. of Entom., Circ. No. 117, 1910, pp. 1-6, 1 fig.

V.—Forestry.

Borthwick, A. W.—A New Disease of *Picea*. Notes R. Bot. Gard. Edin., No. xx, 1909, pp. 259-261, plt. I.

Dr. Borthwick describes under the name of *Curcurbitaria piceae*, n.sp., a fungus which was found attacking *Picea pungens* in Perthshire.

Borthwick, A. W.—Frost Canker of *Picea sitchensis* (Trantv. et Mey.) the Menzies Spruce. Ibid., pp. 263-265, plt. li.

Borthwick, A. W.—Abnormal Branch of *Prunus avium*. Ibid., pp. 267-269, plt. lii.

Thought to be due to some fungus; it evidently belongs to the same category of diseases as Witches' Brooms.

Forbes, A. C.—The Economic Importance of *Scolytidae* in Irish Forestry. Irish Nat., 1910, vol. xix, pp. 89-91, plt. 2.

Jones, W. S.—Pathological Secretory Cavities in Wood. Q. Journ. Fores., 1910, vol. iv, pp. 106-113, 9 figs.

Stebbing, E. P.—The Blue Pine "Polygraphus" Bark Borer (*Polygraphus major*, Steb.). For. Zool. Ser., Leaflet, No. 5, 1910, pp. 1-7, 6 figs.

Stebbing, E. P. The Larger Deodar Bark Borer (*Scolytus major*, Steb.). For. Zool. Ser., Leaflet No. 4, 1909, pp. 1-12, 9 figs.

VI.—Fisheries.

VII.—Medicine and Human Parasites.

Webster, F. M.—A Predaceous Mite proves noxious to Man. (*Pediculoides ventricosus*, Newport.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 118, 1910, pp. 1-24, 13 figs.

VIII.—Animal Diseases, etc.

Beuhne, R.—A Disease affecting European and Victorian Bees. Journ. Dept. Agric. Victoria, 1910, vol. viii, pp. 62-64.

Bevan, L. E. W.—Interim Report on the Animal Trypanosomiases of Southern Rhodesia. Rhodesian Agric. Journ., 1910, vol. vii, pp. 1029-1081, 2 plts.

Breinl, A., and E. Hindle.—Observations on the Life-history of *Trypanosoma lewisi* in the Rat Louse (*Haematopinus spinulosus*). Ann. Trop. Med. and Paras., 1910, vol. iii, pp. 553-564, plts. xix, xx.

Dixon, R. W.—East Coast Fever. Agric. Journ. C. of G.H., 1910, vol. xxxvi, pp. 19-26.

Gaiger, S. H.—A Preliminary Check List of the Parasites of Indian Domesticated Animals. Journ. Trop. Vet. Sci., 1910, vol. v, pp. 65-71.

Gilruth, J. A.—Diseases of Canaries. 17th Ann. Rpt. N.Z. Dept. Agric., 1909, pp. 298-300.

Holmes, J. D. E.—The Treatment of Surra in Horses by means of Arsenic and its Derivatives. Journ. Trop. Vet. Sci., 1910, vol. v, pp. 1-45, 30 figs.

Jowett, W.—Note on an Intestinal Parasite of the Ostrich. Agric. Journ. C. of G.H., 1910, vol. xxxvi, pp. 60-63, 6 figs.

Leese, A. S.—Summary of First Series of Experiments on treatment of Surra in Camels. Journ. Trop. Vet. Sci., 1910, vol. v, pp. 57-64.

Leese, A. S.—Filariae in Vitreous Chamber of the Eye of a Camel—Ophthalmia. Ibid., pp. 89-92, 2 figs.

Marlatt, C. L.—The Horn Fly (*Haematobia serrata*, Rob.-Desv.). U.S. Dept. Agric., Bur. of Entom., Circ. No. 115, 1910, pp. 1-13, 6 figs.

Price, C. A. E. Examination of Bees for Bacterial Disease. Journ. Dept. Agric. Victoria, 1910, vol. viii, pp. 58-62, 2 figs.

Robertson, W.—Notes on Some Diseases of the Ostrich. Agric. Journ. C. of G.H., 1910, vol. xxxvi, pp. 34-41, 4 figs.